JUNE 1961

the JOURNAL of ENVIRONMENTAL SCIENCES

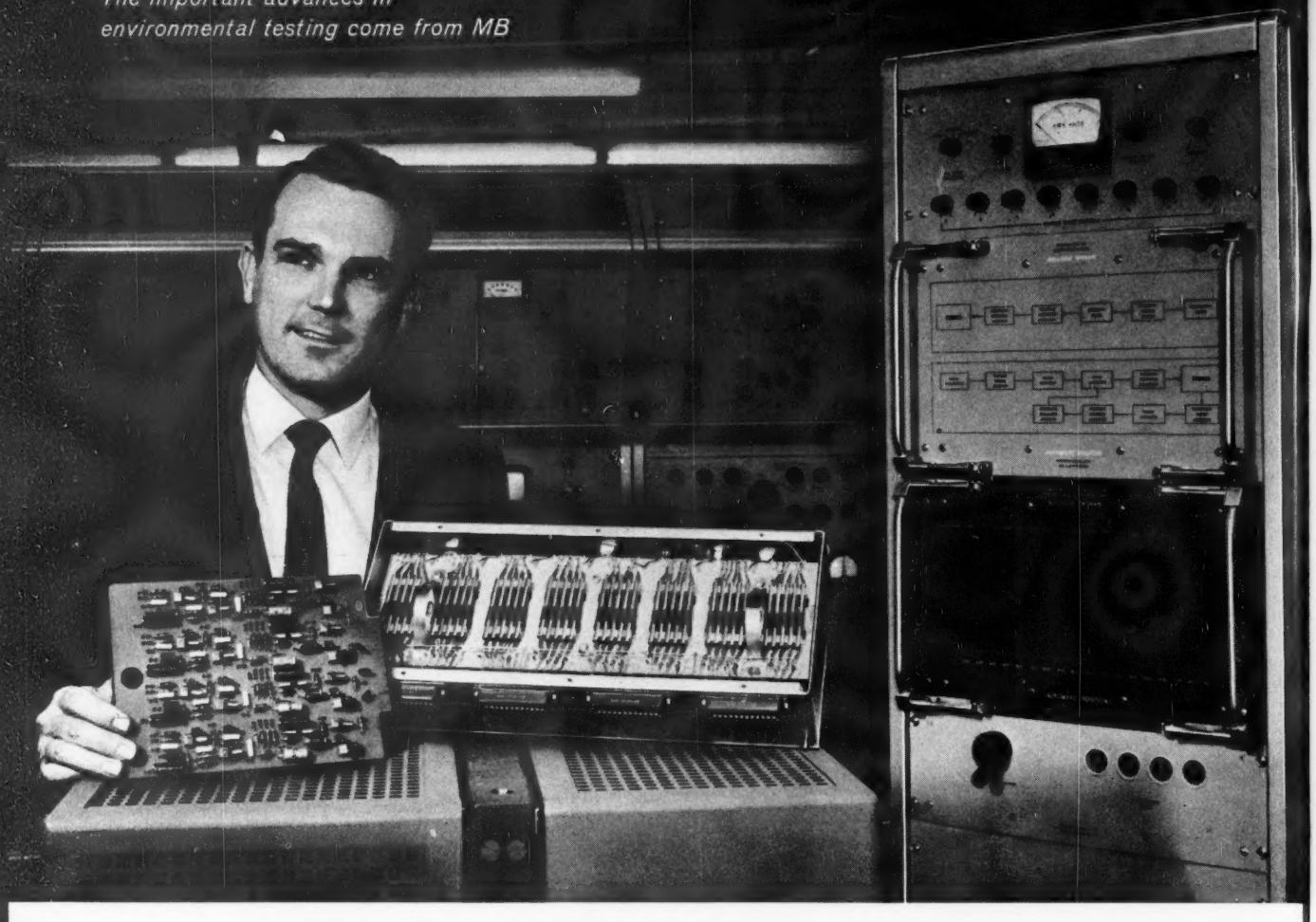
ARTHUR B. BILLET, PRESIDENT
See page 5

THE SEA
AS AN ENVIRONMENT

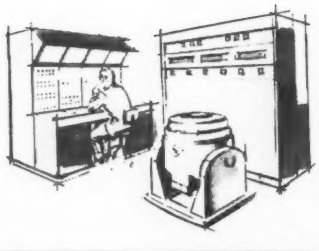
AUTOMATIC THERMAL
SHOCK TEST CHAMBER

ENVIRONMENTAL SOURCE
DATA AND ORGANIZATION

The important advances in environmental testing come from MB



NEW MB automatic spectrum equalizer to revolutionize random vibration testing



Heart of the MB automatic equalization system is the multi-channel transistorized amplifier which provides amplitude control. The plug-in printed circuit assembly shown above contains four of these channels. Frequency control is provided by the 80-channel filter assembly in the compact metal box.

CONSTITUTING a major breakthrough in applied electronics, MB's new *automatic* spectrum equalizer now means not only more accurate vibration testing . . . but tremendous savings as well in test time and money for missile and aircraft manufacturers.

The reason: set-up time has been completely eliminated. Using solid state magnetostrictive filters with correct phase properties plus servo systems on each of eighty channels in the 15 to 2000 cps spectrum, vibration shaker systems can be completely equalized within 5 seconds.

Savings in time and labor over previous equalization methods can easily mean thousands of dollars per missile tested. Still another advantage is the greatly increased accuracy of accumulated test data. The spectrum is continuously monitored in narrow bandpass channels and compensation automatically made *during* test run.

Automatic spectrum equalization is another of MB's important and continuing contributions in the field of environmental testing.

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC., 1082 State Street, New Haven 11, Conn.

VOLUME 4 NUMBER 3

NATIONAL OFFICERS

President
ARTHUR B. BILLET
VICKERS INC.

Executive Vice President
DONALD J. FOX
FENWAL INC.

Fiscal Vice President
MARK CHRISTENSEN
WYLE LABORATORIES

Local Chapter Vice President
GERHARD DOERING
COLUMBIA RESEARCH LABS.

Membership Vice President
HERBERT J. SAUNDERS
VAP-AIR DIVISION
VAPOR HEATING CORP.

Publications Vice President
JOHN D. CAMPBELL
PHILCO CORP.

Past President
WILLIAM L. VANDAL
FORD-AERONUTRONICS

Executive Secretary
HENRY F. SANDER

NATIONAL DIRECTORS

Boston
RALPH MARCUS
RAYTHEON COMPANY

Chicago
JOHN D. LOSSE
AC SPARK PLUG DIVISION, GMC

Mid-Atlantic
DAN GRADY
GENERAL ELECTRIC MSVD

New York
NORMAN PONCE
SPACE-TRONICS

Northern California
CURTIS R. SEYLER
AEROJET GENERAL CORP.

Southern Ohio
JOHN L. CAHILL
LEDEX INC.

Southern Tier
RALPH G. MEZA

the JOURNAL of ENVIRONMENTAL SCIENCES

For active Environmental Engineers and the executives throughout industry who are concerned with the advancement of Environmental Engineering by the Institute of Environmental Sciences.

Henry F. Sander MANAGING EDITOR
John D. Campbell TECHNICAL EDITOR
Raymond Kopriva ART DIRECTOR

ELECTION OF OFFICERS	5
A MESSAGE FROM OUR TECHNICAL EDITOR	6
THE SEA AS AN ENVIRONMENT	7
ENVIRONMENTAL SOURCE DATA AND ORGANIZATION	10
AUTOMATIC THERMAL SHOCK TEST CHAMBER	12
1961 TECHNICAL MEETING HIGHLIGHTS	14
A MESSAGE FROM THE PRESIDENT	16
ABSTRACTS	18
LOCAL CHAPTER NEWS	18
ELECTION OF FELLOWS	20

THE JOURNAL OF ENVIRONMENTAL SCIENCES is published bi-monthly by the Institute of Environmental Sciences at their National office, 34 S. Main St., Mt. Prospect, Ill., CLearbrook 5-1561. The JOURNAL is circulated free to all members of the INSTITUTE OF ENVIRONMENTAL SCIENCES, and is available to others by subscription. Subscription Rates: $5.00 per year (6 issues) in United States and Possessions and in Canada. Single copies: $1.00 per copy when available. Double prices for copies more than six months old. CHANGE OF ADDRESS: Allow 2 months. Please send old address as well as new.

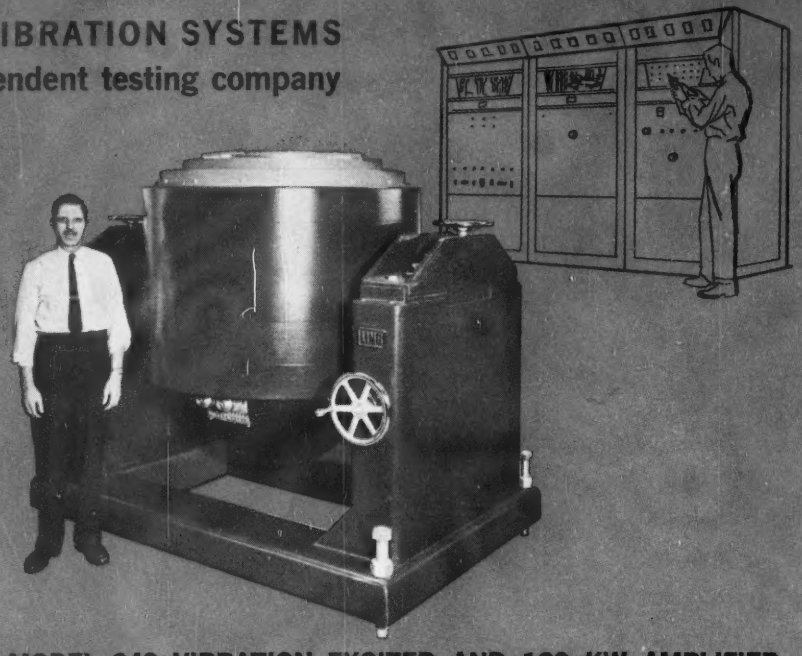
Copyright 1961 by INSTITUTE OF ENVIRONMENTAL SCIENCES.

Send all correspondence regarding subscription, circulation, advertising and editorial material to the office of publication, The Institute of Environmental Sciences, P. O. Box 191, Mount Prospect, Illinois.

We cannot be responsible for unsolicited manuscripts.

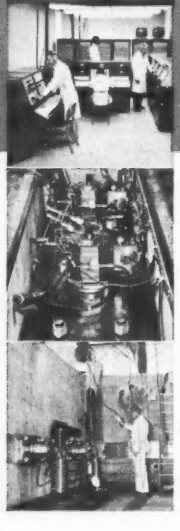
"ON THE AIR!"

LARGEST VIBRATION SYSTEMS
at any independent testing company



NEW LING MODEL 249 VIBRATION EXCITER AND 120 KW AMPLIFIER

This latest addition to Wyle El Segundo's extensive vibration test facilities permits high frequency vibration testing of larger specimens than ever before and the attainment of much higher g levels. The system is rated at 28,000 force-pounds random, 30,000 force-pounds sinusoidal, with accelerations to 75g.



ULTRA-HIGH FORCE HYDRASHAKER SYSTEMS

Only Wyle Offers Hydrashaker Systems for ultra-high force vibration testing in the low to medium frequency range. Three 100,000 force-pound dual head Hydrashaker systems are installed at the Wyle facilities in Norco, California (left), housed in temperature conditioned, remotely operated test pads. Live ICBM and other solid rocket engines are continuously under test here. Additional Hydrashaker installations are available at Wyle-El Segundo.

WYLE LABORATORIES

128 Maryland Street, El Segundo, California

... Other Facilities at
Westbury, New York ...
New Hyde Park, New York
... and Norco, California

ELECTION OF OFFICERS

Donald J. Fox

John D. Campbell

Herbert J. Saunders

William L. Vandal
Past President

The sealed ballot envelopes were taken to the Annual Technical Meeting in Washington, D.C. A committee of Tellers was appointed by Henry F. Sander, Executive Secretary to tally the ballots. This committee consisted of the following Members: **Robert Scholle** *(Chicago)*, Chairman, **Carl Oestreicher** *(Washington, D.C.)*, and **William Vandal,** *(Los Angeles)*. Mr. Scholle read the election results at the Luncheon in the Sheraton Hall on Wednesday, April 5, 1961. The results were as follows:

President — **Arthur B. Billet** (see *cover)*, Senior Staff Engineer, Vickers Inc., Detroit, Michigan. Mr. Billet has been active in the Institute of Environmental Engineers and the Institute of Environmental Sciences since 1956. Since that time he has served on the National Executive Committee as a Vice President. He was the Annual Technical Meeting Chairman for the 1961 Meeting, as well as the Technical Program Chairman for two previous meetings.

Executive Vice President — **Donald J. Fox,** District Manager, Fenwal Inc., Chicago, Illinois. Mr. Fox has worked on Institute activities for a similar period, being active in both the Chicago, Ill. and Dayton Ohio areas. He has been Chairman of both Chapters. His leadership last year was instrumental in the present success of the Chicago Chapter.

Fiscal Vice President — **Mark Christensen,** Wyle Laboratories, El Segundo, California. Mr. Christensen has been active for five years in the Society of Environmental Engineers and the Institute of Environmental Sciences. He served as National Director for the Los Angeles Chapter for two years. He was the Publicity Chairman for the 1960 Technical Meeting in Los Angeles. He has also served as the Education Chairman of the Los Angeles Chapter and played a large part in their University Program.

Local Chapter Vice President — **Gerhard Doering,** District Manager, Columbia Research Labs., Woodlyn, Pennsylvania. Mr. Doering is a former resident of the Boston Area. In 1959-1960 he was the President of the Boston Chapter. During this time the Boston Chapter started their University Program for the chapter. Mr. Doering was appointed to fill the vacancy of Local Chapter Vice President last year.

Membership Vice President—**Herbert J. Saunders,** Chief Test Engineer, Vap-Air, Division of Vapor Heating Corp., Niles, Illinois. Mr. Saunders is a charter member of the Chicago Chapter. He has served as Publicity Chairman, Membership Chairman and Secretary of the Chicago Chapter. He was the Publicity Chairman for the 1959 Technical Meeting in Chicago.

Henry F. Sander
Executive Secretary

Publications Vice President—**John D. Campbell,** Philco Corp., Palo Alto, California. Mr. Campbell was one of the founding members of the Northern California Chapter. He has served as their Membership Committee Chairman, Treasurer, and President and now is the chairman of the Education Committee.

This group met with the new chapter National Directors and made the following appointments:

Roger Amorosi, Electrical Testing Laboratories, Chairman of the Standards Committee.

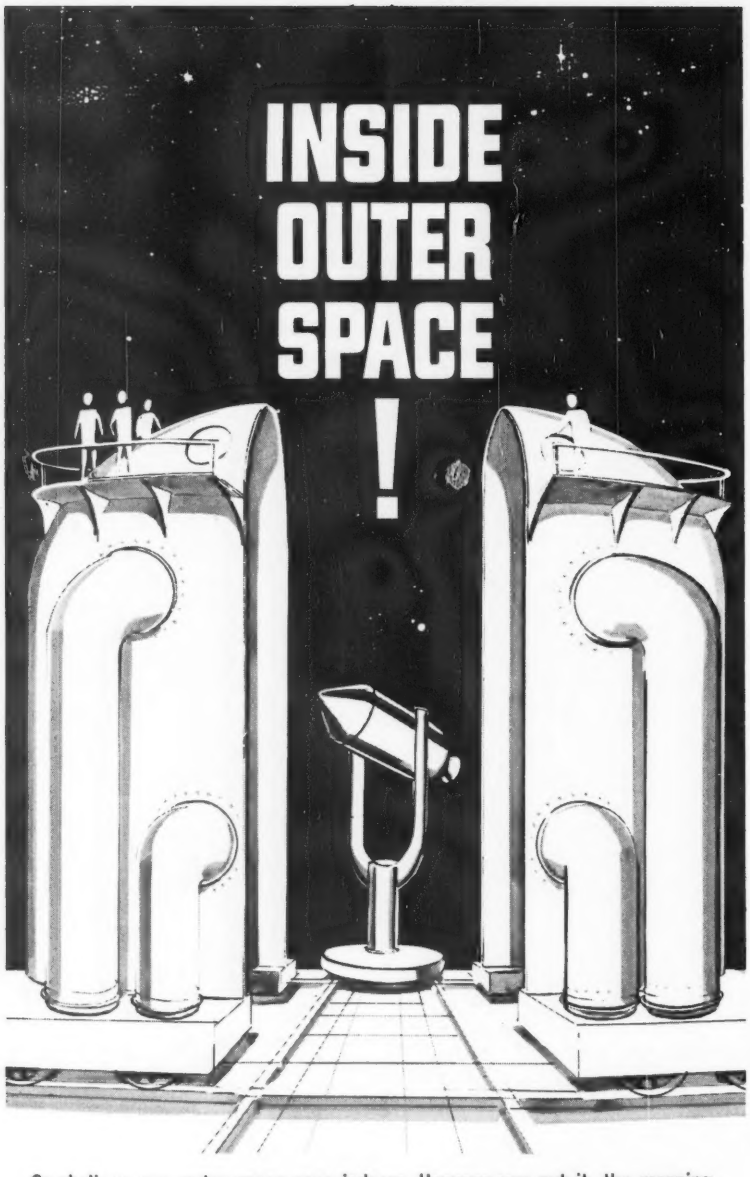
David Askin, Frankford Arsenal, Chairman of the Handbook Committee.

John Campbell, Philco Corp., Technical Editor of the Journal of Environmental Sciences.

Donald Fox, Fenwal Inc., General Chairman of the 1962 Technical Meeting and Equipment Exposition.

Henry Sander, Institute of Environmental Sciences, Executive Secretary, Managing Editor of the Journal of Environmental Sciences and Exhibit Co-Chairman 1962 Meeting.

William Vandal, Ford-Aeronutronics, Chairman of the Education Committee.



Or shall we say, outer space goes indoors. However you put it, the meaning is the same: Tenney has brought the exotic hyper-environments of outer space down to earth — and put them into Space Simulators engineered to create, measure and evaluate the effects of extreme spacial altitudes, solar radiation, blistering heat, cryogenic cold and orbital motion. All to assure the safe and certain progress of space exploration.

Tenney's space simulation engineers, with more combined experience than any other company, can help you with your particular project. Write to Mr. Frank Gardner for further details.

Tenney ENGINEERING, INC. Aerospace Division
1090 SPRINGFIELD ROAD • UNION, NEW JERSEY
OLDEST AND LARGEST MANUFACTURER OF ENVIRONMENTAL TEST EQUIPMENT

A Message From Our Technical Editor

This issue of the JOURNAL, and the next one, primarily will carry technical papers that were given at the April Symposium, but were not included in the Proceedings. This gives us a good source of technical material for these issues, but we need your help in supplying additional papers and articles.

Your help is earnestly solicited in three ways: (1) Submit articles that you have written; (2) Submit abstracts of articles that you have read about environmental topics; and (3) Volunteer as a reviewer of technical articles being considered for publication.

Your interest in the Institute should cause you to support the JOURNAL with all your written output. Talk about writing articles for the JOURNAL at your next chapter meeting.

Several of the most useful technical publications offer a sevrice to their readers by featuring abstracts and indexes drawn from the entire subject field. We can increase the reading efficiency of all JOURNAL readers by starting this service. You may not have material to write an original article, but each member of the society must read at least one article each month that would be of interest and help to all others in our field. Your short abstracts will collectively cover a wide list of subjects, and the usefulness of this system is apparent.

Several members attending the Symposium came forward and volunteered as technical reviewers of future articles. More are needed. If you don't care to offer your own time, please suggest the names of others whom you feel are qualified to read papers under the following classifications: Acceleration, Acoustical Noise, Altitude, Explosion, High Temp., Humidity, Low Temp., Radiation Nuclear, Radiation Solar, Radio Interference, Rain, Salt Spray, Sand & Dust, Shock, Vibration, and Life Sciences.

Please address all replies to:
John D. Campbell
Philco Corp.
Western Development Lab.
3875 Fabian Way
Palo Alto, Calif.

THE SEA AS AN ENVIRONMENT

BY DAVID D. CHAPMAN

The Boeing Company
Bioastronautics Section

To an observer standing on a shore or on the deck of a ship during rough weather, the sea is a forbidding and even frightening phenomenon. The observer is in reality only witnessing interface phenomena, which in nature are usually "special cases" wherever they are found. The immense power of waves, with overpressures of 30 to 100 psi, which can ruin sea-walls, disembowel ships and Texas-towers with equal facility is indeed awesome, and an imposing problem for the engineer attempting to design for permanence and stability in the face of waves of varying periods and heights. Resonance, fatigue, and loss of strength due to deformation are all considerations which require attention. However, the effects of waves are reduced two orders of magnitude at depths of only three-fourths of a wave length. Immediately below this, general calm prevails with only a static pressure force and a steady "prevaling wind" due to normally stable currents. By immersing a structure below the surface then, the extreme mechanical environment of the interface may be avoided, and the remaining problems are the relatively tractable ones of pressure, heat-loss, and corrosion. Static pressure hulls are relatively simple to design and in the case of shallow water structures, where the ambient pressure can be tolerated by humans, even pressure becomes less important.

Structurally, buoyancy forces may become an important design factor since, if the shell must merely contain gas at the ambient pressure, it may be of quite light construction. General design criteria for an underwater site can be considered only if function is first considered.

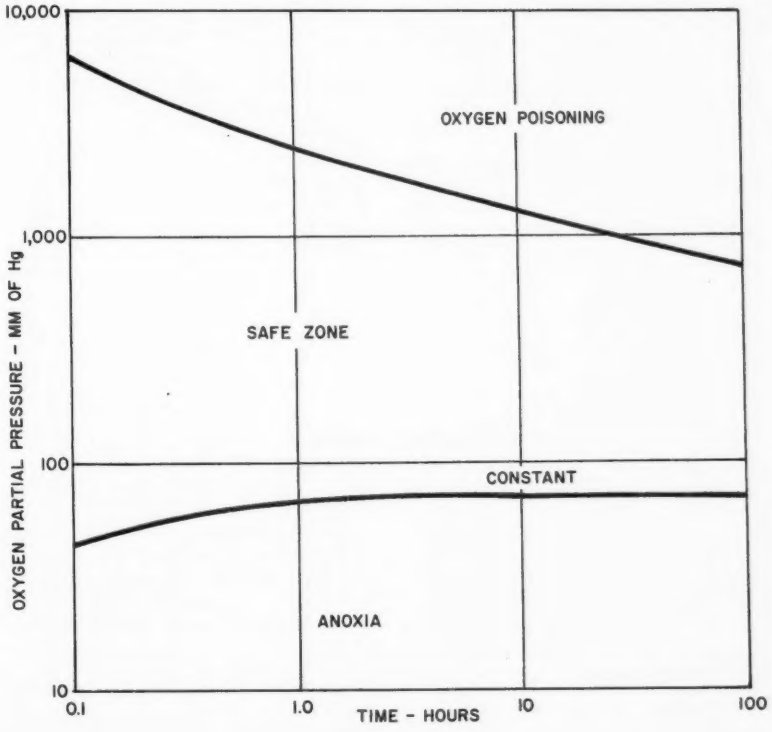
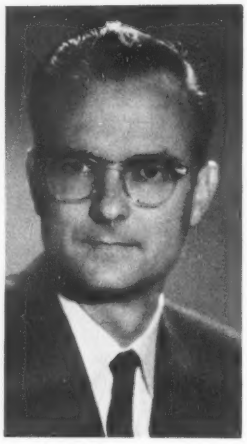


FIGURE 1
Average Time - Tolerance Of Man To Oxygen Partial Pressure

Even if military operational functions are ignored, as they must be for present purposes, there remain manifold uses for a manned underwater station.

With some twenty percent of the nation's oil reserves represented by the continental shelves, oil companies have taken a careful look at the means for exploiting this area. Trails have begun with plastic-covered cylinders for towing and storage of fuel oil and other petrochemicals. The underwater station therefore has application as a terminus for shore pipeline and storage facilities, providing inspection and maintenance services. Other applications of extreme interest to the oil and chemical industries are: submerged drilling rigs free from the violence of the surface; high pressure environments for organic reactions and other industrial processes, such as work with volatile materials. The volatile fraction from oil production may be readily and inexpensively liquified at depth, and transferred in that state to storage or transport. One of the more obvious advantages for the aqueous environment is research on nuclear reactors, with "built in" salt water shielding and a prevaling current away from the workers. Many other research applications may be listed, among the more obvious of which are: geological exploration; seismology; marine biology and ecology; oceanography; acoustics; biochemistry and physiology of high pressures; sonar installations for the establishment of fog-proof shipping lanes; the geophysics of "pure" cosmic rays; an essentially constant low-level radiation environment for radio-carbon dating; magnetic fluctuations, and other applications. In addition, temporary establishment of such facilities is possible for investigation of maritime disasters and for marine salvage operations. With the utility of such a system established, there remains to be discussed some of the problems associated with planting man in such a hostile environment.

During the tenure of advanced forms of life on this earth, atmospheric composition has remained relatively constant. Plants have exerted their influ-



About The Author

DAVID D. CHAPMAN received a Bachelor's degree in Chemistry in 1950 and a Ph.D. in Comparative Biochemistry in 1955 from the University of California (Berkeley). During the tenure of faculty positions with the Universities of California and Washington he produced some fifteen publications concerning metabolic pathways and reaction mechanism studies. Dr. Chapman joined Boeing in May, 1959 and is Senior Bioscientist in the Bioastronautics Section of the Physics Technology Department, where he is working on components of environmental control systems for the advanced vehicle programs and environments for undersea stations.

ence to provide an ample supply of oxygen for the parasitic (animal) forms, and the abundance of the relatively inert nitrogen gas has allowed the plant-life to survive by virtue of a quenching effect on the otherwise disastrously combustible nature of plant material.

In order to minimize internal atmospheric pressures in the space ship and in extraterrestial bases, experiments have been carried out with an environment consisting of one-half atmosphere total pressure in which the decrease is solely due to a reduction of nitrogen, resulting in an artificial atmosphere of 60 percent nitrogen and 40 percent oxygen. The resulting partial pressure of oxygen is that of the normal atmosphere. The internal pressure of the space cabin could be further reduced if toxic effects of higher concentrations of oxygen could be avoided (Figure 1). Actually, at further reduced pressures, pure oxygen might not prove toxic for prolonged periods of use. In some individuals, sensitivity to oxygen is obvious after several hours at one atmosphere of partial pressure. At 3 atmospheres partial pressure, no one is "immune," since at this concentration there is sufficient oxygen in physcial solution in the blood to satisfy metabolic requirements. Under these conditions, hemoglobin remains saturated with oxygen; carbon dioxide transport from the tissues to the lungs is interfered with, since one of the important functions of hemoglobin is based on its ability, in the reduced form to pick up CO_2 which is then displaced by O_2 in the lungs. The result of continuous oxygen saturation then is to interfere with normal acid—base balance relationships, which can have an especially profound effect on the nervous system. At pressures higher than 3 atmospheres of oxygen, seizures similar to idiopathic epilepsy are induced. The condition is completely reversible, and no damage of a permanent nature is apparent. However, the consequences of use of pure oxygen by a diver are obvious.

One other physiological fact of life makes it impossible to use even compressed air for the manned undersea station. Nitrogen narcosis—the "rapture of the deep" made famous by Captain Cousteau's exploits—would become pronounced with ordinary air compressed to the pressures found at depths of more than 100 feet in the sea (Figure 2). The substitution of some other inert gas for nitrogen is therefore necessary. A large literature concerning the physiology of various gas mixtures has been built up; a full discussion of the physical properties of gases which lead to narcosis need not be presented here. Suffice it to say that the higher molecular weight noble gases (argon, krypton, xenon) also narcotize, but helium does not. The use of helium has been emphasized—at least in the United States, which has a virtual monoply on the world's supply—for deep diving operations in order to avoid some of the problems of subsequent decompression and neuropharmacological activity.

Full agreement on the mechanism of this narcosis has not been reached. One possible mechanism involves interference with carbon dioxide diffusion in the tissues. Graham's Law states that diffusion rates are proportional to the square root of the molecular weight, and narcotizing effects also seem to be related to molecular weight. It is by most workers attributed to the fact that nitrogen, argon and the higher noble gases are relatively quite soluble in lipoidal material, so that large concentrations would be found in nervous tissue with results analogous in part to the effects of ether anethesia. Helium, which has a relatively slight solubility in fatty materials, has been used without signs of narcosis at 500 foot depths[1]. This diminished solubility in fats also has a pronounced effect on the susceptibility to the "bends" of the diver using helium oxygen mixtures. The oil-water solubility ration is much lower for helium (see Table I), so that the gas does not remain in sites such as bone marrow for very much longer than it can be stripped from the blood by respiration. For this reason, decompression times for divers using helium are very much less than those necessary when compressed air or other nitrogen mixtures are used. Work on the preparation of decompression tables for divers using helium has been carried out by the Naval Medical Research Laboratories at New London[2].

However, the continuous supply of large volumes of compressed gas to support a station would be prohibitive, especially for non-military functions. What is needed is a mixture which can be produced from the raw materials at the site. The clue to the solution of this problem was provided by the pioneering efforts of the Swedish diver Zetterström[3,4], who made successful dives to over 500 feet with hydrogen—oxygen mixtures. While the concepts of such a mixture, pressurized, causes most people to shudder, if oxygen constitutes four or less percent of the mixture, it cannot explode. Furthermore, both gases are readily available by the simple process of electrolysis of the surrounding medium. The power requirements are mineral, since one man's oxygen supply would involve continuous expenditure of approximately 300 watts. A station at 200 feet in the sea would have an atmosphere of 97% hydrogen and 3% oxygen, a proportion well within the non-inflammable range[5], but providing a normal partial pressure of oxygen.

In confirmation of the oil-water solubility ratio concept, hydrogen was found by Zetterström[3] to require much less decompression time than with compressed air. Initial work with the preparation of decompression tables has

been carried out by the Swedish navy[4].

The problem of returning personnel to the surface after their tissues have been saturated at high pressures with hydrogen is not too difficult. A decompression chamber, with helium immediately substituted for hydrogen, may be made a detachable component of the station and lifted aboard ship; or pressurizable compartments of a submarine would be very suitable. In most cases, a decompression period of a day should allow complete replacement of the hydrogen and subsequently added helium.

Of the problems remaining to be solved, a few merit listing here. Can man do entirely without nitrogen for prolonged periods? His entire evolutionary history has been one of a nitrogen-containing atmosphere.

Will high pressures of hydrogen be metabolically inert during prolonged periods of exposure?

What will be the "metabolic cost" of living and working in such an environment? Can we develop tools and techniques to allow a free diver to be effective in this environment, which is analogous to the zero gravity state in space? And finally, is man able to function for extended periods in a confined space surrounded by a hostile environment?

REFERENCES

1 Behnke, A. R., Jr., *Harvey Lectures,* 198 (1942)

2 Personal Communication, Cdr. George Bond

3 Zetterström, A., *Military Surgeon 103,* 104 (1948)

4 Bjurstedt, H., Severin, G., *Military Surgeon 103,* 107 (1948)

5 Case, E. M., and Haldane, J. B. S., *J. Hygiene 41,* 225 (1941)

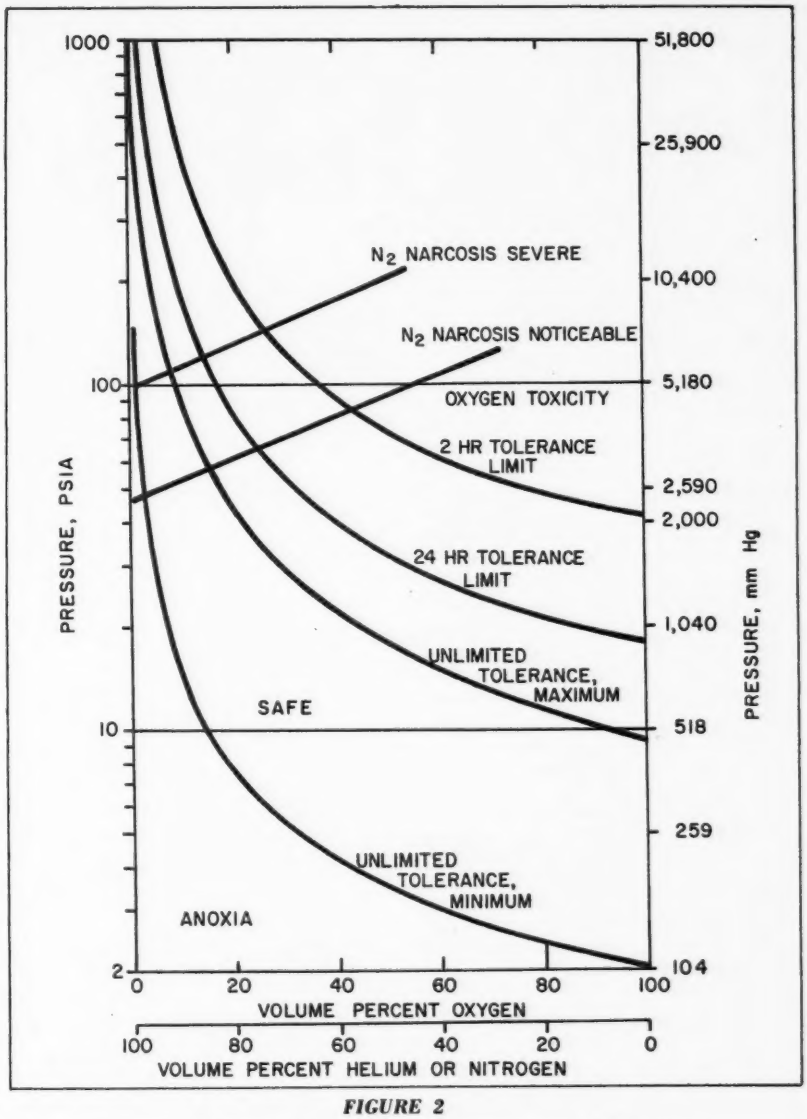


FIGURE 2
Human Tolerances To Atmospheric Composition And Pressure

SOLUBILITY OF GASES IN OIL AND WATER AT 38°C

	WATER	OLIVE OIL	OIL-WATER SOLUBILITY RATIO
Hydrogren	**0.017**	**0.036**	**2.1**
Helium	**0.009**	**0.015**	**1.7**
Nitrogen	**0.013**	**0.067**	**5.2**
Argon	**0.026**	**0.14**	**5.3**
Oxygen	**0.023**	**0.11**	**4.9**

TABLE 1

Environmental Source Data And Organization

BY ELLSWORTH F. SEAMAN

U. S. Dept Of Navy
Bureau Of Ships

General Parameters

Sources for the factors entering into environmental design criteria are virtually endless. Present day engineering design guidance needs extend beyond, and are superimposed on, the more common and conventional environments. The frozen polar regions, the deepest parts of the sea and the limitless expanse of outer space contribute to complexity in engineering design. Maximum simplicity in definition of environmental factors, accurate evaluations of significance, and elimination of conflicting requirements are elements that are needed to achieve the highest degree of confidence in the end product.

Authoritative environmental source material becomes increasingly critical in order to keep pace with the needs in exploration of the unknown as in the Trieste dive to a depth of seven miles and total water pressures of 200,000 tons;[1] the problem of lubrication, or the rate of evaporation of most metals in the hard vacuum of outer space;[2] the problems posed by the permafrost layer along the DEW (Distant Early Warning) line.

These are but a few concrete examples of measurable environmental conditions and their effect. They are individual conditions uncomplicated by multiple combinations of factors and sequences of occurences. Design criteria developed from such direct source material are ideally simple but unfortunately seldom encountered. These basic source data when used to establish performance and test requirements for materiel and design criteria for systems, lose their discrete identities. They are often combined with many other factors with the integrated result represented by a single derived requirement. In a like manner the measurement of performance may consist of a test method intended as simulative of field conditions and accelerated for reasons of economy in time, money, and manpower.

Source Material Validity Check

The extrapolation of basic environmental source data into its final form for use as design criteria is suspect unless the checks and balances necessary to validity of the requirements are vigorously applied. The operation requires a combination of technical, administrative and management skills where the starting point is an analysis of the problem generating conditions such as are indicated in a generalized check-off list of potential difficulties including:

Common performance requirements are scattered throughout too many specifications so that unnecessary conflicts in requirements develop.

Incomplete or ambiguous specifications do not provide the basis for good design criteria.

Inadequate or non-significant test methods are specified. These tests may not simulate the service conditions.

Test methods are in conflict in the sense that the methods are intended to impose equal environmental severities but do not provide equivalent answers for design guidance.

Test method significance is not understood.

There is no authoritative handbook guidance where tests for each environmental area may be grouped together with explanation of background, interpretation, limitations and relationship with other methods.

Many sources of diverse and uncoordinated terminology exist.

More educational emphasis on Environmental Engineering is needed.

A more organized and coordinated approach is needed for collection of field environmental data as associated with materiel and system performance.

Extrapolation as to future requirements is sketchy. Conclusions are based on inadequate analysis or background.

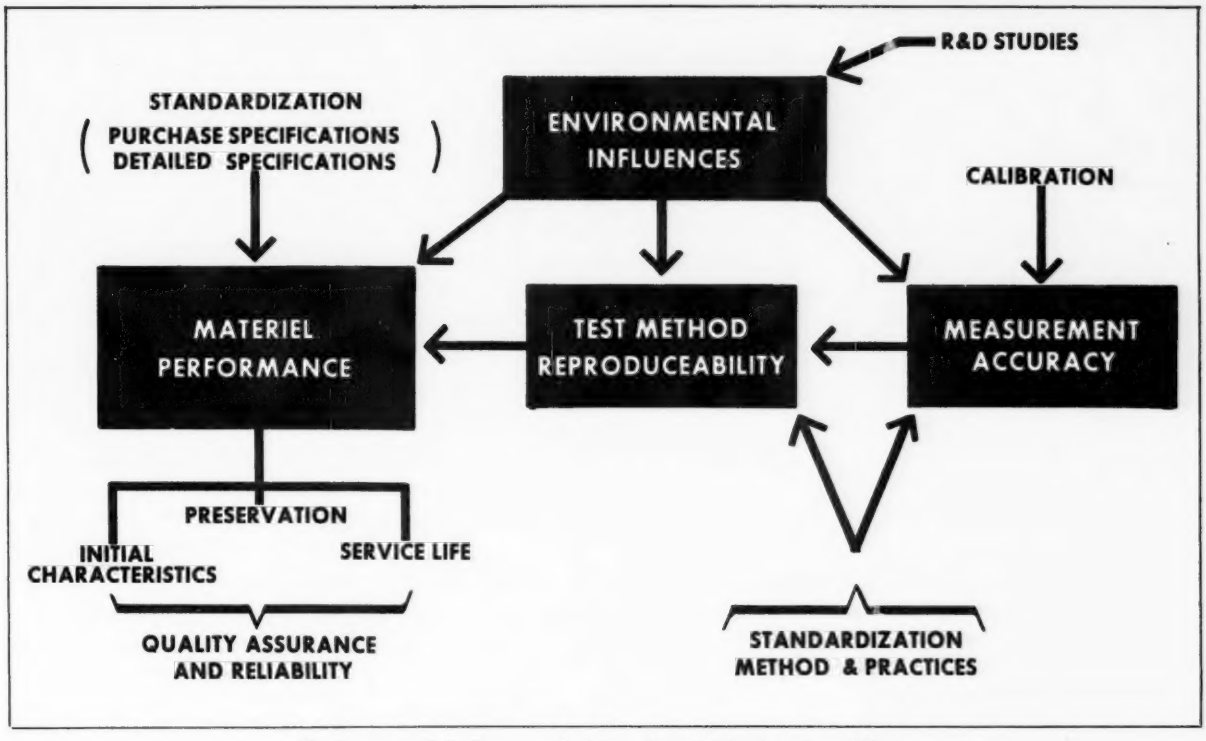
There are blind spots in fundamental knowledge and in using information al-

[1] National Geographic, August 1960.
[2] Werhner von Braun in Prevention of Deterioration Center Newsletter, April 1961.

About The Author

ELLSWORTH F. SEAMAN attended the Carnegie Institue of Technology, Pittsburgh, Pennsylvania where he majored in Electrical Engineering. After leaving school he worked for public utility light and power companies in Pennsylvania, New York, Alabama and Texas. In 1931 he took a position with the Bureau of Engineering (now the Bureau of Ships), Navy Department where he has worked in the fields of Research and Development as well as Standardization. Much of this work has involved Environmental Engineering problems. He is currently Head of the Standardization Assurance Engineering Branch of the Bureau of Ships.

Mr. Seaman has received many citations and awards including the Navy Distinguished Civilian Service Award, is the author of numerous papers, holds several patents, is a registered Professional Engineer, is vice-chairman of the ASTM Simulated Service Test Committee and is International Chairman of the Committee for Basic Climatic and Mechanical Tests in the International Electrotechnical Commission.



Environmental Influences And Coordinated Engineering Effort

ready available.

Requirements may not be supported by service feed-back information.

Planned Approach for Improvement

Recommendations for reduction in or elimination of the shortcomings which have been indicated begin with the statement of need for a nationally integrated plan for the work so that the more significant and high priority areas may be identified and so that available manpower may be most effectively used. More specifically and in terms of inadequacies cited herein constructive thinking followed by corrective action are the basis for the suggestions that:

Government and industry could enter into a dynamic program of analyzing and classifying specification requirements for the purpose of reducing the number of source points for derived environmental criteria. This includes analysis of differences between industry and government requirements and bringing them into agreement when feasible. Clarification of requirements is an integral part of the task.

Undertake the task of developing more meaningful simulative service tests with stress on closing the gap between tests on basic materials and tests on end products using these materials.

Adopt as a standard procedure the prefacing of each environmental test method with the philosophy behind the test and a statement of intended test significance.

Adopt as standard practice the initiation of a program to develop a collation factor when a previously used method is revised.

Develop an environmental test method handbook [3] for reference use by engineers in writing specifications.

Make a study to develop recommendations leading to better and more long range forecasts of future requirements that must be used for design criteria.

Encourage the use of a uniform and centralized system of environmental information storage and retrieval. In such a system feed-back data would be more readily available for improvement in design criteria. Information already available could be organized so that needed R&D effort could be pinpointed where fundamental knowledge is lacking.

Develop standard approach patterns to the collection of environment-operational data through the use of multichannel tape recordings.

Expedite the work on standardization of terminology through the IES sponsored project in the American Standards Association.

And finally, provide an adequate committee structure within the IES so that problem solution and adequate interchange of ideas will be accelerated. The kinds of committees would be based on the need, and might include the following:

Planning—Includes design of experiment and test program plans as well as long range planning in general.

Scope—Proposed scope of each new project should be examined to eliminate conflict with existing effort.

Coordinating—Make studies to coordinate the various kinds of effort so that the different fields of engineering including Human Engineering, and the technologies such as materials, mycology, climatology, and meterology may

[3] Proposed in I.E.E. paper at the Chicago Meeting, April 1956.

Continued on page 26

Automatic Thermal Shock Test Chamber

BY VERNON L. BRADFIELD

Collins Radio Co.
Western Division

As we extend our domain into the space environment, the emphasis in the environmental field appears to be shifting more and more toward the gross testing and evaluation of end products. And as acceptance tests and testing become more exotic, they obscure the fundamental fact that a rigid component parts testing and selection program is still the most sound, most economical way of ensuring end product reliability. The point is this; component parts testing is still a vitally important part of our work. While progress in space-age acceptance testing methods is impressive, perhaps even spectacular, progress is also being made in the testing of component parts, as evidenced by this article.

The environmental lab at Collins Radio Company tests thousands of electronic components and assemblies each month in order to maintain the high standards of reliability of our product line. Like most environmental labs, we have been plagued by excessive man-hours spent in overseeing lengthy temperature cycling and thermal shock tests, using separate "hot and cold boxes". As a result, and we hope of interest to those faced with the same problem, we designed and built a fully-automatic Thermal Shock Chamber (T.S.C.) at the Western Division.

The T.S.C. was designed primarily to meet the exact requirements of Mil-Std-202B tests for temperature cycling (Method 102A) and thermal shock (Method 107A). This Standard specifies that separate chambers shall be used for the extreme temperature conditions of the test cycle (steps 1 and 3) and that room temperature exposures separate each extreme (steps 2 and 4). Each chamber must have a sufficient thermal capacity to attain the specified ambient temperature within two minutes after the test samples have been introduced into the chamber. Forced air circulation is also specified. Using these specifications as minimum limits, the T.S.C. was designed to cover a wide range of controlled temperature testing and component aging operations. After selecting the test conditions, the T.S.C. will control and record up to ten complete test cycles automatically.

Figure 1 is a full view of the T.S.C., showing the location and function of its major components. The basic T.S.C. consists of two controlled temperature chambers separated by a segmented test area drum (Figures 2 and 3). A reversible, rotary-drive mechanism locates the test area of the drum in one of three positions; the lo-temp chamber, the hi-temp chamber, or facing the outside (for loading and room temperature steps 2 and 4 of the test cycle).

The temperature in both chambers is regulated by on-off cycling. Liquid CO_2, controlled by a solenoid valve, is used as the coolant in the lo-temp chamber. The use of liquefied gas greatly simplified the design and construction of the T.S.C.'s lo-temp chamber. The expansion of CO_2 into the chamber will cool it to $-65°C$ in less than two minutes. With a room ambient of 25°C, the lo-temp chamber will stabilize over the long term at $-73°C$. To conserve the coolant, CO_2 is released only when the test area is in the lo-temp chamber. The hi-temp chamber is heated by two-600 watt resistive heating elements. Since it requires approximately 20 minutes to bring the hi-temp chamber up to 150°C (maximum T.S.C. limit due to test drum expansion), the hi-temp chamber temperature is maintained throughout the entire test period. Both chambers are lined with stainless steel and insulated with three inch thick foam plastic.

The test drum is of special significance, since the T.S.C. commands its uniqueness and versatility primarily because of this one component. The test drum receives a greater continuous thermal shock than any speciment it will test, because of its location. The high thermal stress placed on the drum was a major concern in specifying the material for the drum. Nopco "Lockfoam",[1] a new, cast-in-place foam plastic was selected as the drum material because of its suitable characteristics of low density, low thermal conductivity, low coefficient of expansion, adequate shear strength, and relative ease of forming. The complete casting procedure is too lengthy to be discussed here, except to mention that the "Lockfoam" mixture releases gas, forming a cellular plastic mass which expands to the exact shape of the mold cavity. Sponge silicon rubber, which remains serviceable at temperatures ranging from $-90°C$ to 260°C, was used for the gasket seals between the chambers and the drum.

As mentioned previously, on-off cycling regulates the temperature in each cham-

About The Author

VERNON L. BRADFIELD has been with the Collins Radio Company, Science Information Center, for the past ten years. The last five years he has been in charge of the Component Evaluation and Environmental Test Laboratory. He is a graduate of the Los Angeles Valley College with current courses at the University of California in Los Angeles. Prior to his association with Collins Radio Company he spent four years with the U.S. Navy during World War II as Flight Engineer, and two and one half years with Lockheed Aircraft in Evaluation of Fuel Systems.

Mr. Bradfield is a Member of the INSTITUTE OF ENVIRONMENTAL SCIENCES *and a member of the Los Angeles Aren Chapter.*

ber. Chamber temperature is sensed by bulb-type temperature sensing elements mounted in the output path of each blower. This information is relayed from the sensors to their respective temperature selectors by a change in liquid volume. Each temperature selector functions as an indicator and a controller. Physical deviation of the temperature indicator pointer toward or away from the selected temperature pointer opens and closes a set of electrical contacts, providing the on-off cycling. This type of temperature control was used because, of the "hardware" available for the purpose, the units selected were lower in cost, easier to install, simpler to operate, and had larger, easier to read, dials.

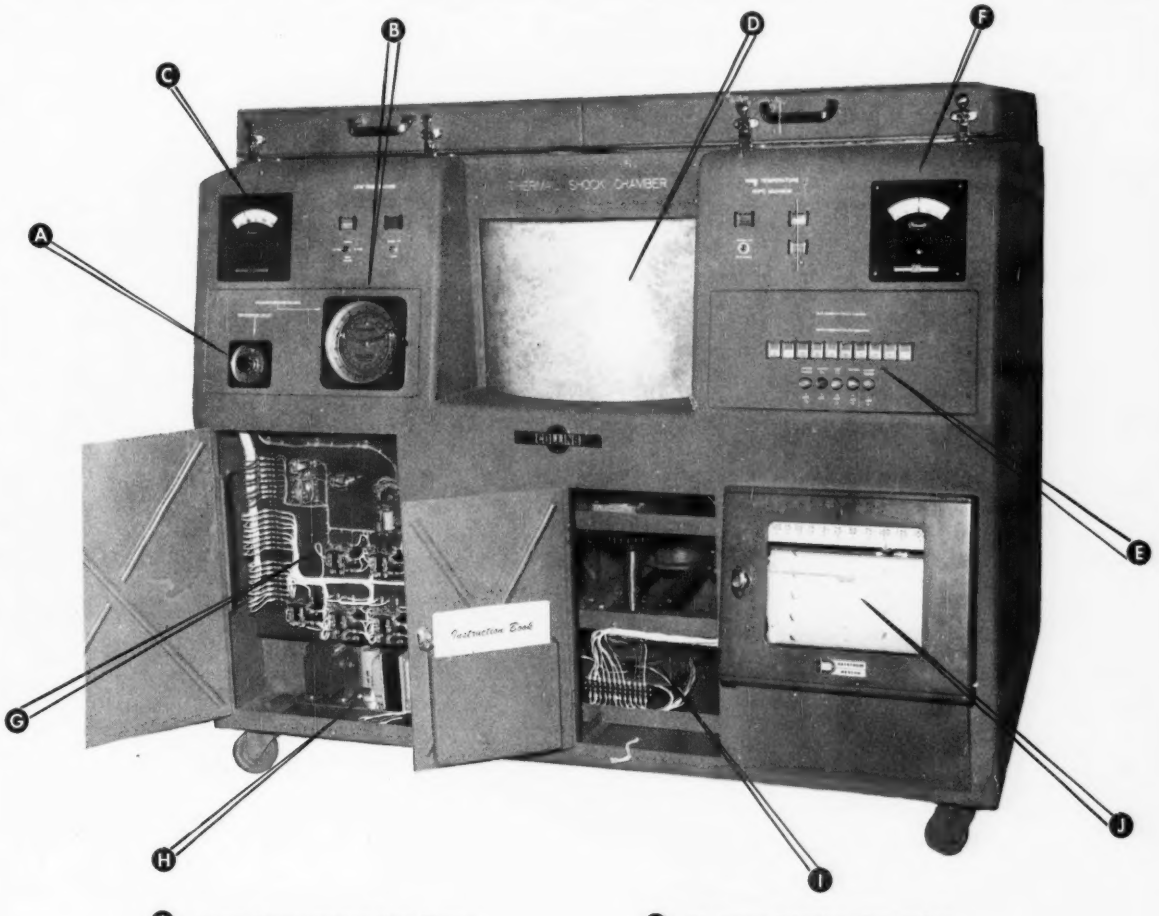
The drum drive mechanism is of interest, because of the high torque required to accelerate the drum together with the design requirement that the drum move from one test step area to the next within two seconds. The mechanism consists of a set of reduction gears coupled to a one-third horsepower motor through a Dodge "Flexidyne" [2] coupling. The "Flexidyne" is a dry fluid coupling, the dry fluid being heat-treated steel shot. A measured amount of shot, called the flow charge, is placed in the housing of the coupler. For this application, the coupler housing was keyed directly to the motor shaft. When the motor first starts, it comes up to

Continued on page 22

References

1 "Lockfoam" is a trade name of Nopco Chemical Company, North Arlington, New Jersey.

2 "Flexidyne" is a trade name of Dodge Mfg. Corp., Mishawaka, Indiana.



- A Room Temperature Step Timer
- B Lo-Temp, Hi-Temp Step Timer
- C Lo-Temp Selector-Controller
- D Segmented Test Drum
- E Number of Cycles Selector (1 to 10)
- F Hi-Temp Selector-Controller
- G Power, Timing, and Control Relays
- H Control Voltage Power Supply
- I Test Drum Positioning Cams
- J Pen Recorder

FIGURE 1
Collins Thermal Shock Chamber

HIGHLIGHTS—1961 ANNUAL MEETI

Thursday's Prime Beef Luncheon, held in the Sheraton Hall was greatly enjoyed by the 625 participants at this high point in the program. Looking at the photos you will be able to identify attendees from the

West coast, Midwest, and Eastern Seaboard. Engineers and Scientists also came from Canada, Denmark, England, France and Sweden.

Three aisle views of the Exhibit Hall in the Sheraton Park occupied. We were fortunate in having the N.A.S.A. Godd They had the largest public display of Satellites ever exhibi

ETING AND EQUIPMENT EXPOSITION

Mr. and Mrs. Peter Grootenhuis of England viewing the N.A.S.A. Exhibit. Mr. Grootenhuis is the Vice President of the Society of Environmental Engineers in England.

The Ladies Program had 45 registrants. The above photo was taken as they left for the Soviet Embassy. All returned.

Mr. Kurt Stehling of N.A.S.A. was the Luncheon Speaker on Thursday. His talk, "The Challenge of Space" was most timely. Mr. Scott Crossfield of "X-15" fame and North American Aviation spoke at Wednesday's Luncheon.

n the She ton Park Hotel. There were a total of 71 booths the N.A. A. Goddard Space Flight Center as an Exhibitor. atellites e r exhibited.

A MESSAGE FROM YOUR PRESIDENT

ARTHUR B. BILLET

The successful manned entry into the threshold of space, as symbolized by the Mercury Project flight has placed added emphasis on the challenge of space and its environments. This is a challenge to the individual environmental engineer as well as the Institute of Environmental Sciences.

In man's exploration of space in the short 60 year time period, we have seen vehicle speed change from 38 miles per hour to more than 25,000 miles per hour; and we have seen vehicle gross weight change from 600 pounds to approximately one-half million pounds.

To accomplish these phenomenal vehicle performances, study and technology advances in the environmental field have had to expand at an even more phenomenal rate. In recognition of the problems that were involved in environmental study, simulation, and design, the Institute of Environmental Sciences, together with its predecessor organizations, was formed in 1955 to provide a clearinghouse of information and a central focal point for the environmental engineer.

Indicative of the need and growth of an organization of this type, the Institute has grown in less than seven years from one Chapter with a few members, to ten Local Chapters and 1,100 members throughout the United States. Our national meeting growth has changed also, from the 170 that attended the first meeting to approximately 1,000 that attended our last meeting.

It is indeed gratifying that many of the Institute of Environmental Sciences members contributed to the successful Mercury Project flight, and that many more are right now engaged in additional space challenges in connection with lunar probes and the actual exploration of outer space.

It is for these ever increasing challenges that the best efforts of the engineer, the company, and the Institute of Environmental Sciences will be put forth for this coming year and for many years to come.

ORIGINAL PAPERS SOLICITED

For the

Institute of Environmental Sciences
Annual Technical Meeting in Chicago
April 11, 12 and 13, 1962

Theme: Product Improvement Through Environmental Science

Abstracts must be must submitted on or before 1 October 1961

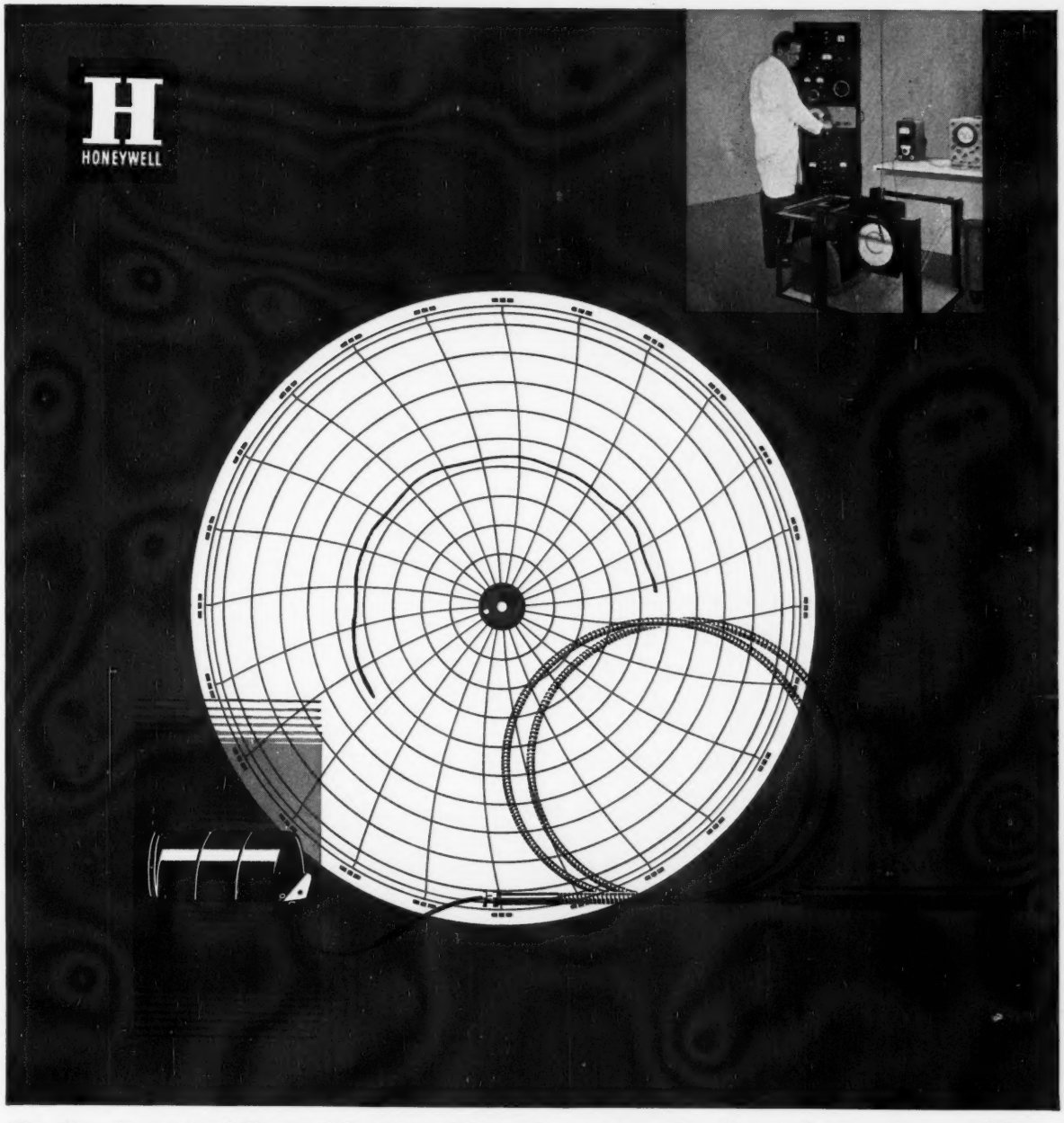
Final papers must be submitted on or before 10 January 1962

Paper selections will be made by Technical Program Committee based on originality, timeliness and scope.

Submit abstracts to:

F. P. Merry, Technical Program Chairman
1817 So. Chaparro
Las Cruces, New Mexico

or: Institute of Environmental Sciences
Post Office Box 191
Mount Prospect, Illinois



The New Honeywell Thermal System withstands extreme vibration and corrosion conditions

Here's a new gas-actuated thermal system that takes the zig-and-zag out of temperature recording under severe vibration conditions.

A complete series of vibration tests has proved the vibration resistance of the new Class III thermal system. In these tests (shown above), the Class III system was installed in a standard Honeywell rectangular case recorder, and subjected to forced vibrations in three mutually perpendicular planes. With accelerations up to 0.2G from 0 to 200 cps, maximum pen oscillation was limited to 1.5%. For more than 75% of the range, pen oscillation was less than 0.5%, with no resonant effects at 60 cycles.

Get the complete story by contacting your nearby Honeywell field engineer. Minneapolis-Honeywell, Wayne and Windrim Aves., Phila. 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ont.

Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL Sales and Service offices in principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

ABSTRACTS

An Investigation of a Perennially Frozen Lake

By David Barnes,
A. F. Cambridge Research Labs

Perennially-frozen Angiussaq Lake, Greenland was examined in 1957 to determine the strength of its midsummer ice cover and the causes of its perennially-frozen conditions. The lake is the largest within a 100-mile radius of Thule Air Base and is formed by ice-cap damming of a valley 200 m deep. It has an elevation of 590 m.

Water temperatures ranged from 0.1° to 0.7°C and showed that summertime mixing is sufficient to maintain nearly isothermal conditions. Fish, phytoplankton, and chironomid life were found in the lake water.

At the end of the 1957 summer, more than 90 percent of the lake surface was covered by ice averaging 1.5 m in thickness. Variations in melting rate have caused a gently rolling surface that might be smoothed by flooding or scraping. In-place cantilever beam tests showed that the upper half meter of ice had almost no strength but that the lower portion maintained sufficient strength to support heavy loads throughout the summer.

Obtainable from U.S. Dept. of Commerce
Ref. AFCRL-TN-60-660
Office of Technical Services
Washington 25, D.C.

CRITICAL ENVIRONMENTS ENCOUNTERED BY HIGH-ALTITUDE VEHICLES

By: B. V. Wacholder and E. Fayer

This paper describes highlights of a current study program to determine the environmental effects on vehicles and equipment traveling in the fringes of the Earth's atmosphere and out to the surface of the moon. The ultimate objective of this study is to establish design criteria for the development of instrumentation to monitor environments deleterious to the vehicles or the equipment. The instrumentation requirements can be established only after a thorough study of the environments and an analysis of the interactions of the environments on space vehicle materials and equipments. The effort was therefore divided into two phases.

The first phase consists of establishing what vehicles are contemplated by the Air Force for the next ten years or so and what environments these vehicles will encounter. The second phase consists of an analysis of these environments as they affect those vehicles contemplated and what instruments will be required to fulfill the monitoring requirements to prevent the failure of the vehicle mission.

Obtainable in the 1960 Meeting Proceedings. See ad on page 21.

BIOLOGICAL EFFECTS OF MICROWAVE RADIATION.

Volume II—Proceedings of Fourth Annual Tri-Service Microwave Conference

The ultimate objective of the Fourth Annual Tri-Service Microwave Conference, held August 16-18, 1960, was to define how microwaves can be used safely.

The papers in the present volume range from discussions of fundamental considerations of the molecular responses of living tissues to microwaves, through reports concerned with the physical characteristics and measurement of microwave energy, to the organizational and administrative problems of establishing programs of protection. BIOLOGICAL EFFECTS OF MICROWAVE RADIATION will be of considerable value to all those concerned with radar hazards and their prevention.

Obtainable at $10.00 per copy from
PLENUM PRESS, INC.
227 West 17th Street
New York 11, N.Y.

See page 6

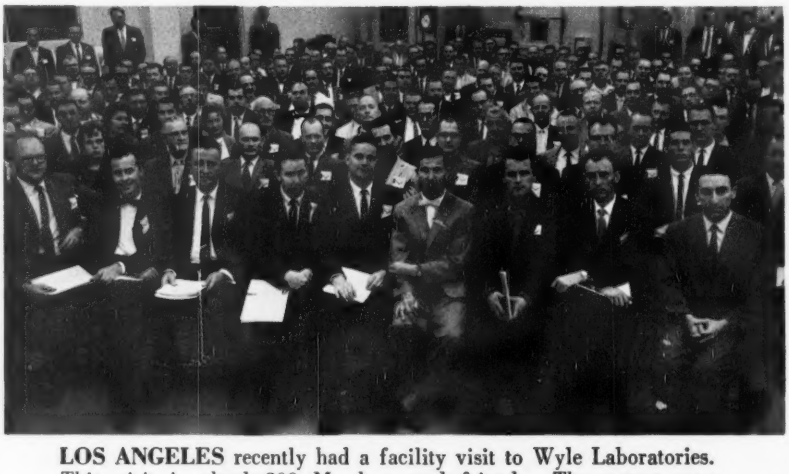
LOCAL CHAPTER NEWS

BOSTON conducted their installation of Officers at Northeastern University and finished up with a technical session presented by Mr. William Cox of Chadwick-Helmuth Co., concerning "Strobe Techniques for Vibration Study." The Boston Chapter is also conducting a Measurements and Instrumentation Series at Northeastern University. Further information can be obtained from their newly elected President Mr. Elmo Pacini of the Raytheon Co., in Sudbury, Mass.

DETROIT, while this Chapter is not officially recognized by the National organization, they refuse to die. On June 5, 1961 they held a dinner meeting in Grand Rapids, Mich. Mr. Neal Granick, Head of the Vibration Laboratory at the N A S A Goddard Space Flight Laboratory and well known Institute Member, offered "A Philosophy for the Space Age."

MID-ATLANTIC met on May 23rd at Cavanaugh's Restaurant in Philadelphia. Their speaker was our re-elected National Vice President (See page 5) Gerhard Doering of Columbia Research Laboratories. Mr. Doering reviewed the field of Instrumentation for Shock and Vibration Testing. A 100 page Handbook covering the general principles in this field was distributed.

NORTHERN CALIFORNIA met on June 5, 1961 at Moore's Prime Rib Kart where they were fortunate to listen



LOS ANGELES recently had a facility visit to Wyle Laboratories. This visit involved 200 Members and friends. The young man seated sixth from the left is Mark Christensen, our newly elected National Vice President. (See page 5)

to a chapter member, Mr. Leon V. Omelka of Lockheed speak on "The Design and Use of Oil Film Vibration Systems." Chapter President John Biberdorf of Philco Corp., announces their August 7th meeting. The subject will be "Data Handling Systems as Applied to Environmental Testing."

SAN DIEGO held their last meeting for the Spring season on May 10, 1961. The season was finished off with a steak dinner and an excellent technical presentation by Mr. James Chadwick, General Manager of the Chadwick-Helmuth Co., who spoke on "Stroboscopic Vibration Techniques."

SOUTHERN TIER finished off the Spring Season by touring the West End Brewing Co. in Utica, New York. The problem of 3.2 storage in a Space Station P.X. was discussed but not solved.

COLORADO has activity brewing in the Denver area. Mr. Jerome Bakalish, Past President of the Los Angeles Chapter, presently with The Martin Company can supply further details to those interested.

ORANGE COUNTY, CALIF. is a proposed new local chapter. Mr. Bob Inabinette of Pacific Scientific Co., 6280 Chalet Drive, Bell Gardens, Calif. is the Chairman of the Steering Committee.

WASHINGTON, D.C. while the recent scene of great Institute activity is also considering the formation of a local chapter. Mr. Neal Granick of N A S A Goddard Space Flight Center, Greenbelt, Maryland, is the Chairman of the Steering Committee.

EDITOR'S NOTE

Mr. Chapman's and **Mr. Seaman's** papers were presented at the Institute's Technical Meeting at the Sheraton Park Hotel, Washington, D.C., April 5, 6, and 7, 1961. These papers do not appear in the 1961 Meeting Proceedings.

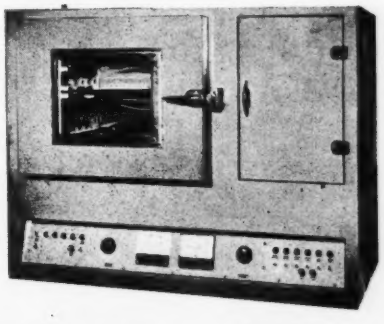
NEW YORK Norm Ponge, outgoing President congratulates Dick Hahn of U. S. Testing Co., on his election as President of the New York Chapter. Mr. Ponge was elected the Chapter's National Director.

Reliable, Consistent Test Results With . . .

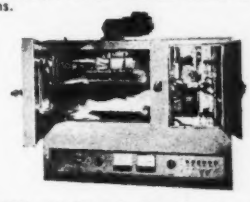
OREC 0300 ***Automatically Controlled Ozone Test Chambers***

REPRESENTATIVE CUSTOMERS UTILIZING OREC OZONE TEST EQUIPMENT

Anaconda Wire & Cable Co.
E. I. DuPont de Nemours & Co.
Esso Research & Engineering Co.
Firestone Industrial Products
General Electric Company
General Tire & Rubber Co.
B. F. Goodrich Research Center
Goodrich Gulf Chemical Co.
Goodyear Tire & Rubber Co.
General Motors Corporation
Phelps Dodge Corporation
Phillips Chemical Co.
Texas U.S. Chemical Co.
TLARGI, U.S.C.
U. S. Rubber Company
Shell Chemical Corporation



Orec 0300 Series employ an *electronic-chemical loop feed back servo system to achieve and precisely maintain chamber ozone concentrations.



Orec 0300 with Dynamic Stretching Apparatus.
* *patent pending*

OZONE:

- TEST CHAMBERS, 6 MODELS
- AUTOMATIC CONTROL SYSTEMS
- RECORDING INSTRUMENTATION
- STRETCHING APPARATUS
- MEASUREMENT INSTRUMENTATION
- GENERATORS
- TESTING SERVICE
- RESEARCH & DEVELOPMENT

Write for illustrated brochure

Ozone Research and Equipment Corporation

3840 North 40th Avenue **Phoenix, Arizona**

ROGER J. AMOROSI

DAVID ASKIN

JOHN CAMMARATA

JOHN M. THOMPSON

JOHN YOST

ELECTION OF FELLOWS

ROGER J. AMOROSI received his B.E.E. and M.E.E. degrees from Cornell University. He was with Sperry Gyroscope for two years conducting tests and analysis of wing servo-mechanisms. He then joined Parameters Inc. where he became President and General Manager. He recently joined Electrical Testing Laboratories as Assistant Chief Engineer.

Mr. Amorosi is a registered Professional Engineer in the state of New York and a member of the New York State of Professional Engineers. He is also a member of the A.I.E.E. and Sigma Xi. He was a charter member of the steering committee for the Science Section of the Environmental Equipment Institute which was the foundation for our present organization. He has been President of the Institute of Environmental Engineers and conducted the liason and mechanics for the merger with the Society of Environmental Engineers. He has also been President and National Director of the New York Chapter of the Institute of Environmental Sciences. He presently is serving as the National Chairman for the Institute's Standardization Committee.

Mr. Amorosi has given technical presentations on environmental testing before the Professional Engineers Society and the Long Island Electronic Manufacturing Council.

DAVID ASKIN received his B.A. in Mathematics and Physics and his Pennsylvania College Teaching Certificate from the University of Pennsylvania. He received his B.S. in Electrical Engineering from Lehigh University. His experience includes; two years as Mechanical Engineer, Fire Control Instrument Gages, Ordnance Corps, four years Deputy Director of Research and Development Laboratory Philco Refrigerator Div., two years Chief Environmental Lab., Aeronautical Electrical and Electronic Lab., Naval Air Development Center and ten years as Chief, Environmental Lab. (Test and Evaluation Branch) Research and Development Corps, Frankford Arsenal.

Mr. Askin has lectured on environmental engineering subjects at Hofstra College, Long Island, N.Y., Fairleigh-Dickenson University, Teaneck, N.J., Northeastern University, Boston, Mass. and Penn State University in Philadelphia.

He is a member of the American Society of Heating, Refrigeration and Air Conditioning Engineers, an Associate Member for the Panel on Environmental Research of the Army Committee on Environment, U.S. Army Ordnance representative to D.O.D. Environmental Standards and Specifications Coordination Activities.

Mr. Askin is the Past President and National Director of the Mid Atlantic Chapter of the Institute of Environmental Sciences. He was highly instrumental in the success of our 1961 Annual Technical Meeting. He served as Technical Program Co-Chairman and as such obtained half of the speakers. He presently is serving on the Institute's Education, Handbook and 1962 Technical Program Committees.

JOHN CAMMARATA received his B.E.E. from Polytechnic Institute of Brooklyn and his M.B.A. from Hofstra College. He has been with Arma Division, American Bosch Arma Corp. for the past fourteen years working up to his present position of Manager, Product Reliability.

He is a registered Professional Engineer and a member of the National Society of Professional Engineers. He also is a member of the Eta Kappa Nu and the A.I.E.E. He has served on the Executive Committee of the New York Chapter of the Institute of Environmental Engineers and was instrumental in the firm establishment of the Institute of Environment Engineers in September 1958. He served as Technical Program Co-Chairman for the New York Chapter 1960 Symposium.

Mr. Cammarata has given numerous technical presentations both oral and published. Some of these are: Development of Shock and Vibration Test Methods for Packaging; The Role of an Environmental Section in an Engineering Department; A Review of Environmental Test Equipment; Facilities and Test Equipment Section of the Environmental Handbook (McGraw-Hill).

JOHN M. THOMPSON attended Rutgers University and has done post graduate work at Penn State receiving a certificate in R & D management.

He has spent 17 years in managing United States Air Force Test Facilities. Five of these were at the Watson Laboratories, A.M.C. The remaining 12 were at the Rome Air Development Command U.S.A.F. Until recently he was the General Manager of Itemlab, Inc. He is now enjoying a well earned extended vacation.

Mr. Thompson is a Senior Member of the I.R.E., a member of the Professional Group of Engineering Management, Professional Group on Audio, A.I.E.E., A.S.M., I.S.A., and an associate member of the American Society of Heating, Refrigeration and Air Conditioning Engineers. He is also listed in Who's Who in the East.

He has presented papers entitled, "Environmental Testing for R & D," "Instrumentation for Environmental Testing," and "Test Facilities Laboratory RADC."

JOHN YOST was awarded the B.S.E.E. degree by Kansas State University. He presently holds the position of Engineering Department Head for Environmental Test Laboratory. Since 1946 he has been in charge of all centralized environmental test activity at Sperry. During the previous six years with Sperry he was engaged in the operation of a high altitude laboratory, and in project and product engineering on air-borne fire control equipment.

Prior to joining Sperry, he worked variously as test, application, design, and project engineer, including five years with General Electric, and four years with Long Island Lighting Company.

Mr. Yost is a member of A.I.E.E. and Sigma Tau. He served as Technical Program Co-Chairman for the New York Chapter 1960 Symposium.

On April 5, 1961 the Institute of Environmental Sciences Executive Committee met at the Sheraton Park Hotel. **Mr. Leon Carver,** retiring Membership Vice President recommended the upgrading of several members from the status of Member to that of Fellow. All recommendations were approved by the Executive Committee. These are the new "Fellows".

INSTITUTE of ENVIRONMENTAL SCIENCES MEETING PROCEEDINGS

Year	Cost Member	Non-Member
1956	$8.00	$12.00
1959	$8.00	$12.00
1960	$8.00	$12.00
1961	$9.00	$14.00

The above Meeting Proceedings can be obtained from the National Office of the Institute of Environmental Sciences, Postoffice Box 191, Mt. Prospect, Illinois at the indicated rates.

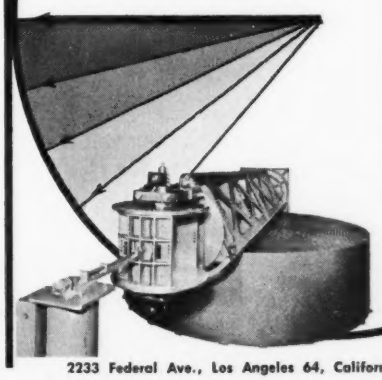
Please make checks payable to the Institute of Environmental Sciences

LABORATORY PRODUCTION SERVO-PROGRAMMABLE

PRECISION

accuracy to 1/100,000 of a G

CENTRIFUGES



Genisco Centrifuges meet the most varied and critical demands for acceleration testing and calibration throughout missile, aircraft, and electronics fields . . . the extreme accuracy for critical calibration of inertial guidance systems . . . the ruggedness for routine product reliability tests and evaluation . . . capabilities for programmed servo control . . . many optional accessories.

Genisco's 931 Series G-Accelerators feature crystal-controlled oscillator to hold allowable drift to .001% from angular velocity of main rotating arm or outboard table . . . Calibration speeds preset to customer specifications within .5 to 30 g range . . . Direct-coupled synchronous drive motors . . . Loading maximums: 25 lbs. fixed platform; Model available with 10 lbs. outboard table . . . Varied modes including sinusoidal or spatial orientation.

The Genisco Model 460 Precision Centrifuge provides 0.25 to 25 g range, accuracy to 1/100,000 g in the range of 1 to 12.5 g's. Payloads are 400 lbs. (36" cube) on the environmental end of the boom; 50 lbs. (16" cube) on the precision end . . . Dynamic radius comparator.

Genisco INCORPORATED

2233 Federal Ave., Los Angeles 64, California

Continued Thermal Shock

speed under no-load conditions. Simultaneously, the flow charge is thrown against the perimeter of the housing by centrifugal force, packing it between the housing and an impeller connected to the load. After the starting period of slippage between the housing and the impeller, the two become locked together at full-load speed, operating at 100 percent efficiency. By varying the flow charge, the coupler can be set to slip at any desired load, giving accurate overload protection.

Drum positioning in each of the three test areas is controlled by microswitches operated by cams on the drum drive shaft. A cam depressed microswitch removes power from the drive motor and simultaneously activates a magnetic brake, preventing drum position override.

Two timers control the test step time intervals of the T.S.C. The time intervals of both the hi-temp and the lo-temp exposures are set on one 5-hour timer. The timer can be set for a minimum of three minutes in one chamber and a maximum of four hours and fifty-seven minutes in the other chamber. The time intervals may be varied anywhere within the above limits as long as the sum of both settings does not exceed the five hour capacity of the timer. The other timer (0 to 30 minutes) controls the intervening room-temperature time periods. Setting this timer to zero results in maximum ther-

SPECIFICATIONS FOR THERMAL SHOCK CHAMBER

(1)	LOW TEMPERATURE LIMIT	-73°C
(2)	HIGH TEMPERATURE LIMIT	150°C
(3)	CONTROL TOLERANCE	±3°C
(4)	MAXIMUM TEST SAMPLE SIZE	7 x 11 x 8 inches (approx)
(5)	MAXIMUM TEST SAMPLE WEIGHT	20 pounds
(6)	EXTERNAL SIZE	Depth - 47 inches Height - 54 inches Width - 65 inches
(7)	SETUP TIME	Less than 1 minute
(8)	TEST AREA SWITCHING TIME FROM ROOM AMBIENT TO EITHER CHAMBER	2 seconds
(9)	TEST AREA SWITCHING TIME FROM EITHER TEST CHAMBER TO ROOM AMBIENT	2 seconds
(10)	TEST AREA SWITCHING TIME BETWEEN CHAMBERS	3.8 seconds
(11)	INITIAL PULL-DOWN TIME: 25°C to -65°C	Less than 2 minutes
(12)	INITIAL PULL-UP TIME: 25°C to 150°C (High temperature is maintained for complete test)	20 minutes
(13)	POWER REQUIREMENTS	115 volts, 60 cps, single phase; 20 amps
(14)	CO_2 CONSUMPTION AFTER PULL DOWN (-65°C) (CO_2 is consumed only when test area is in low temperature chamber)	8.0 pounds/30 minutes

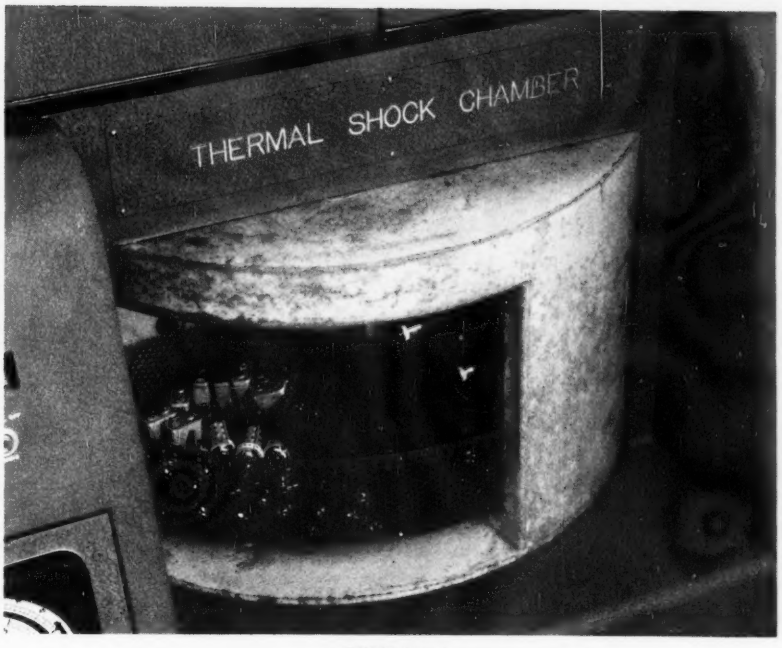


FIGURE 2
T.S.C. Test Area Drum

mal shock conditions; that is, moving the test area directly from one temperature chamber to the other.

At the beginning of a test run, the number of complete cycles (steps 1, 2, 3, and 4), which will make up the test, is selected by pushing one of ten numbered pushbutton switches. During the test, each numbered switch lights in turn to indicate the number of cycles completed. At the end of the test run, when the pre-selected number of cycles have been completed, the entire T.S.C. shuts down. All of the interval timers and cycle selectors actuate relays which form the test drum motor control (see the T.S.C. Control Block Diagram, Figure 4).

A wide-strip pen recorder keeps a linear-time record of the test conditions sensed by a thermocouple mounted in the test area of the drum. Figure 5 is a portion of the record of an actual Mil-Std-202B thermal shock test, run automatically with the T.S.C. The specified test cycle consisted of 30 minutes at −65°C (+0°−5°C) followed by 5

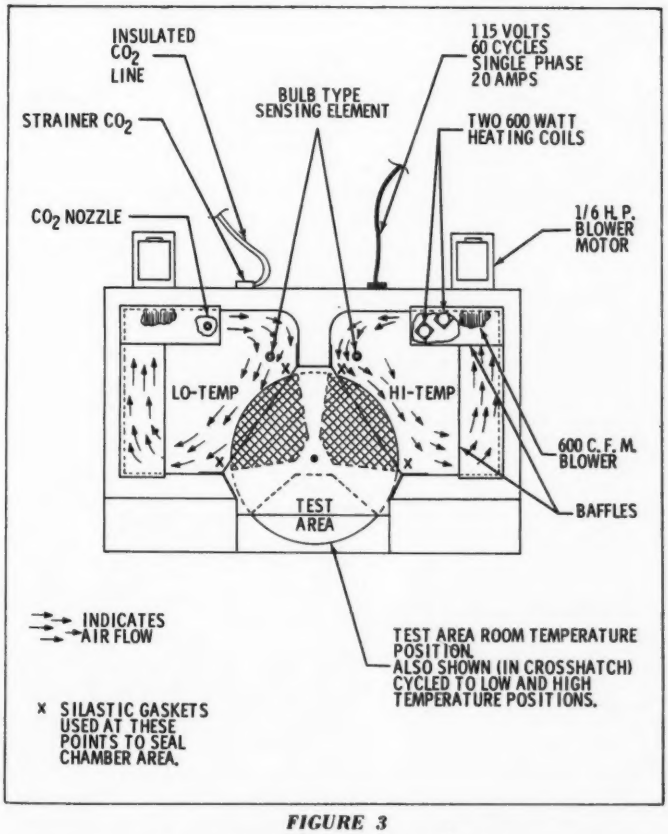

INSULATED CO_2 LINE
115 VOLTS 60 CYCLES SINGLE PHASE 20 AMPS
BULB TYPE SENSING ELEMENT
STRAINER CO_2
TWO 600 WATT HEATING COILS
CO_2 NOZZLE
1/6 H.P. BLOWER MOTOR
LO-TEMP
HI-TEMP
600 C.F.M. BLOWER
TEST AREA
BAFFLES
INDICATES AIR FLOW
TEST AREA ROOM TEMPERATURE POSITION. ALSO SHOWN (IN CROSSHATCH) CYCLED TO LOW AND HIGH TEMPERATURE POSITIONS.
X SILASTIC GASKETS USED AT THESE POINTS TO SEAL CHAMBER AREA.

FIGURE 3
T.S.C. Functional Diagram, Top View

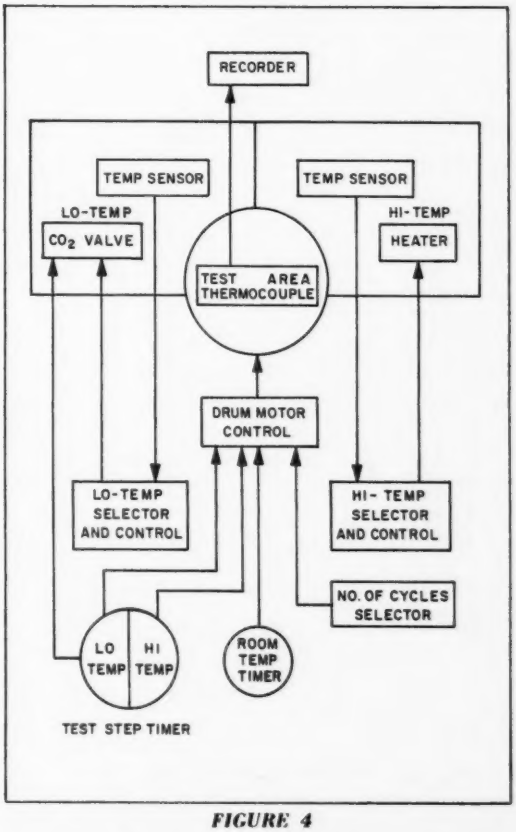


FIGURE 4
T.S.C. Control Block Diagram

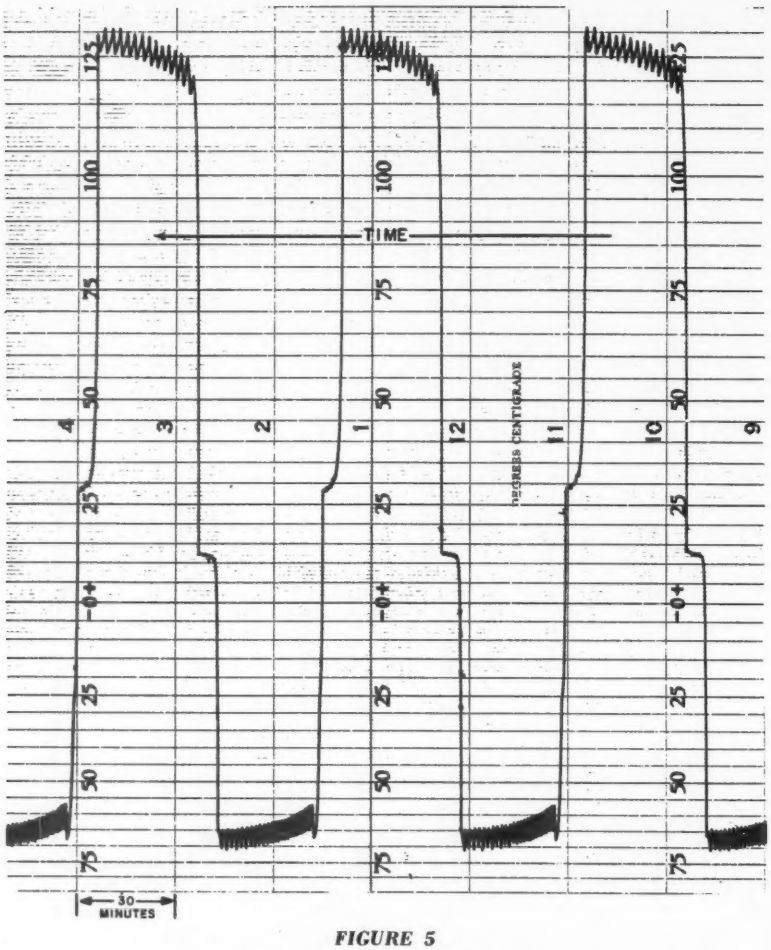


FIGURE 5
T.S.C. Thermal Shock Test Record

Loading Test Area

minutes at room temperature; then 30 minutes at 125°C (+3°−0°C) followed by 5 minutes at room temperature. Note that Figure 5 should be read from right to left.

Evaluating the pen recording, the sawtooth traces at the temperature peaks are due to temeprature control on-off cycling. The amplitude of these traces is ±3°C, or 3°C greater than the specified tolerances. However, by setting the maximum temperature 3°C higher (or lower, in case of lo-temp), the temperature swing is kept within the minimum tolerance limit. The average creepage over the 30 minute periods is an indication of heat transfer as the sample approaches temperature stability. The recorder thermocouple picks up this creepage because of its close proximity to the test sample. This effect is aggravated as the mass of the sample increases or as its thermal conductivity decreases. Since the effect is present in all thermal tests of this nature, and in no way affects the specified chamber ambient limits, it is considered normal.

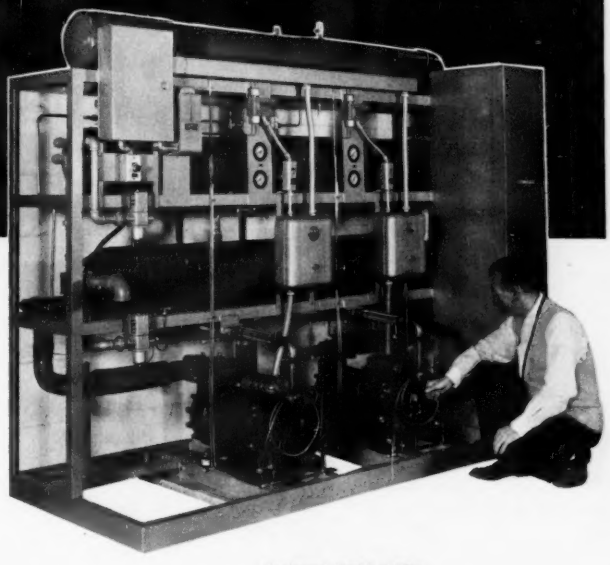
Regarding Figure 5, two other points should be mentioned. There is approximately a 15 degree difference between the two room temperature periods of each test cycle (steps 2 and 4). This also is an effect of the sample's thermal retention, and in no way indicates that the specified ambient conditions have not been met. Also note the three minute lag in the transition from room temperature to lo-temp conditions (step 4 to step 1). This lag was caused by a deficiency in the design of the coolant system (the CO_2 line was too large), which has since been corrected.

The economic advantages of the T.S.C. are obvious. A test technician can set up an entire 12 hour test in less than a minute. By scheduling shorter runs during normal working hours, the longer tests, which involve overtime, can be run, unattended, at night. The T.S.C., therefore, effectively increases our normal working hours thermal testing capacity by better than 100%. Also, it relieves the test technician for more demanding work.

The T.S.C. has other practical advantages. By all but eliminating the human factor, test conditions are easily duplicated. Between tests, many engineering groups use the chamber to "age" potted components and assemblies. The automatic Thermal Shock Chamber is another step taken by Collins Radio in an effort to remove "the chore" from our environment.

Name the environment

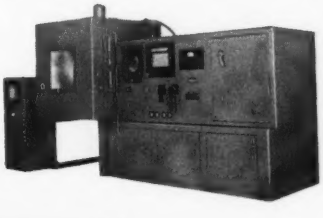
Conrad will help you get it



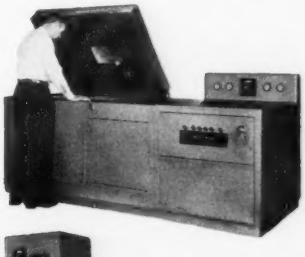
Your environmental test problems are probably as familiar to us as our own street address. We manufacture more than 50 stock model chambers . . . and we've made some 200 different types of specials. We're always glad to have your inquiries. Our design experience and production capacity are at your service. Do you have our catalog? May we send it?

Packaged liquid chiller for −100° F. operation.

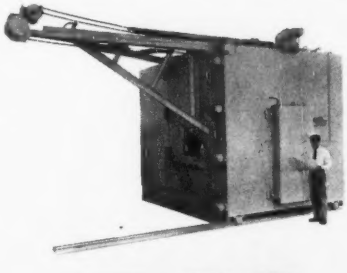
Typical Conrad Environmental Test Chambers



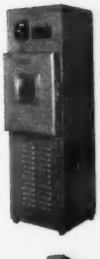
Cat. No. 60502 — Temperature - vibration - altitude, with radiant heating.



Cat. No. 58707 — Standard 8 cu. ft. chest, −100° F. to +300° F.

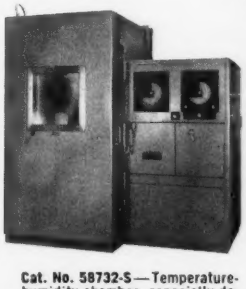


1,000 cu. ft. walk-in chamber. Altitude - temperature - humidity - rain.

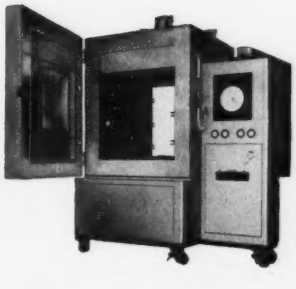


Cat. No. 60101 — Temp-Rac 19, small components test chamber, range −90° F. to +350° F.

Cat. No. 61201 — Multiple temperature baths, +30° F., 0° F., −20° F., −60° F., −90° F.



Cat. No. 58732-S — Temperature-humidity chamber, especially designed for electronic system relay racks.



Cat. No. 61202—30 cu. ft. temperature test unit, with pass-through doors.

CONRAD Inc.

CONRAD, INC.

CONRAD SQUARE, HOLLAND, MICHIGAN

A subsidiary of Crampton Manufacturing Company

Continued ORGANIZATION

contribute to the field of Environmental Engineering most effectively.

Liaison—With other technical societies, both national and international. Particular emphasis is suggested in the area of International Electrotechnical Commission TC 50.

Education

Research

Professional Standards—This committee would develop definitions of kinds of effort in Environmental Engineering leading to a classification system for personnel engaged in this field of endeavor.

Awards

Quality Assurance

Environmental Data Collection

Information Storage and Retrieval

Environments—There should be a task group or subcommittee for each of the discrete environments as well as one for combined environments.

Simulated Service Testing

Standardization—This committee name is suggested instead of "standards" so that broad coverage rather than individual document emphasis is conveyed. The terminology project would fall under this committee.

Coordinated Engineering Effort

Many types of coordinated engineering and other effort are needed to deal effectively with the ideas that have been discussed. They include, as is illustrated in the adjoining chart: research and development, standardization, quality assurance or reliability, and a program of accurate measurement and calibration. Our basic need for more fundamental knowledge depends on input from the field of research. This is the foundation for practical and realistic specifications that reflect the environmental performance requirements. These documents are generally the design criteria used for contract procurement. The meaningful measurement of specified performance values depends on reproducible test methods. Controlled environments both during testing and in the calibration of the measuring instruments are essential to maintenance of needed accuracies. It is the purpose of the chart to illustrate graphically the interaction among the various types of effort and how the success of any one part is dependent on the support of the other parts in a well-balanced program.

Summarization

In summarization, the point has been made concerning the need for authentic and dependable environmental source material for use as design criteria. General obstacles that retard the realization of this objective have been cited. Some recommendations have been included as approaches to problem solution. These recommendations involve the whole field of Environmental Engineering and organization of the effort therein. Whether these are useful or better ones should be developed depends on future study and implementation. It is certain that improvement and effective progress are not realizable unless there is concerted effort in the direction of coordinated planning and action.

DEPENDABLE operation and accurate tests can only be assured through constant research and the use of highest quality materials and workmanship. Murphy & Miller test equipment is manufactured to the highest standards with quality the prime objective. The true meaning of dependability becomes vital when it is considered that an entire production schedule often hinges upon . . . a dependable test.

MURPHY & MILLER Inc.
ENVIRONMENTAL TEST EQUIPMENT

600 West Taylor Street, Chicago 7, Illinois

ETL
SPECIALISTS IN *LABORATORY* MEASUREMENTS

ELECTRICAL
ELECTRONIC
PHYSICAL
PHOTOMETRIC
CHEMICAL

at

SPECIFIED ENVIRONMENTAL CONDITIONS

Bulletin available on request.

Specializing in:

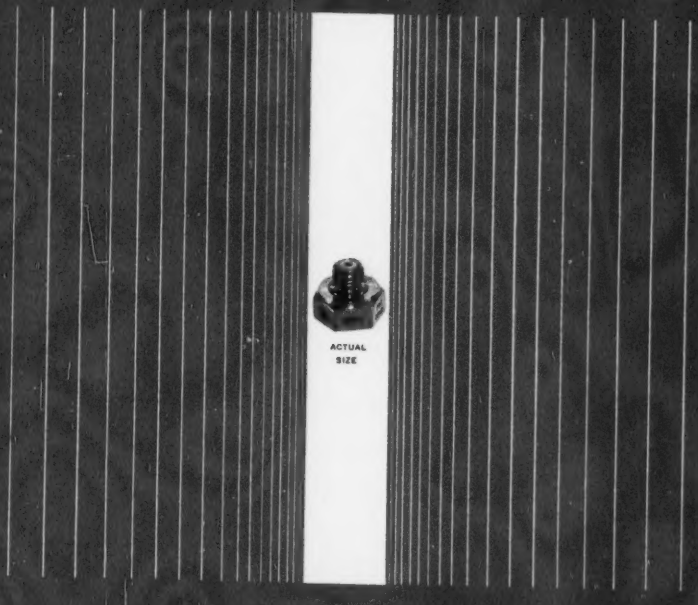
- Measurements at microwave frequencies
- Calibration of instruments and standards
- Qualification tests per Mil-Specs.

Member—American Council of Independent Laboratories

ELECTRICAL TESTING LABORATORIES, INC.
2 East End Ave., New York 21, N. Y.
BUtterfield 8-2600, Area Code, 212

dynamic instrumentation Σ

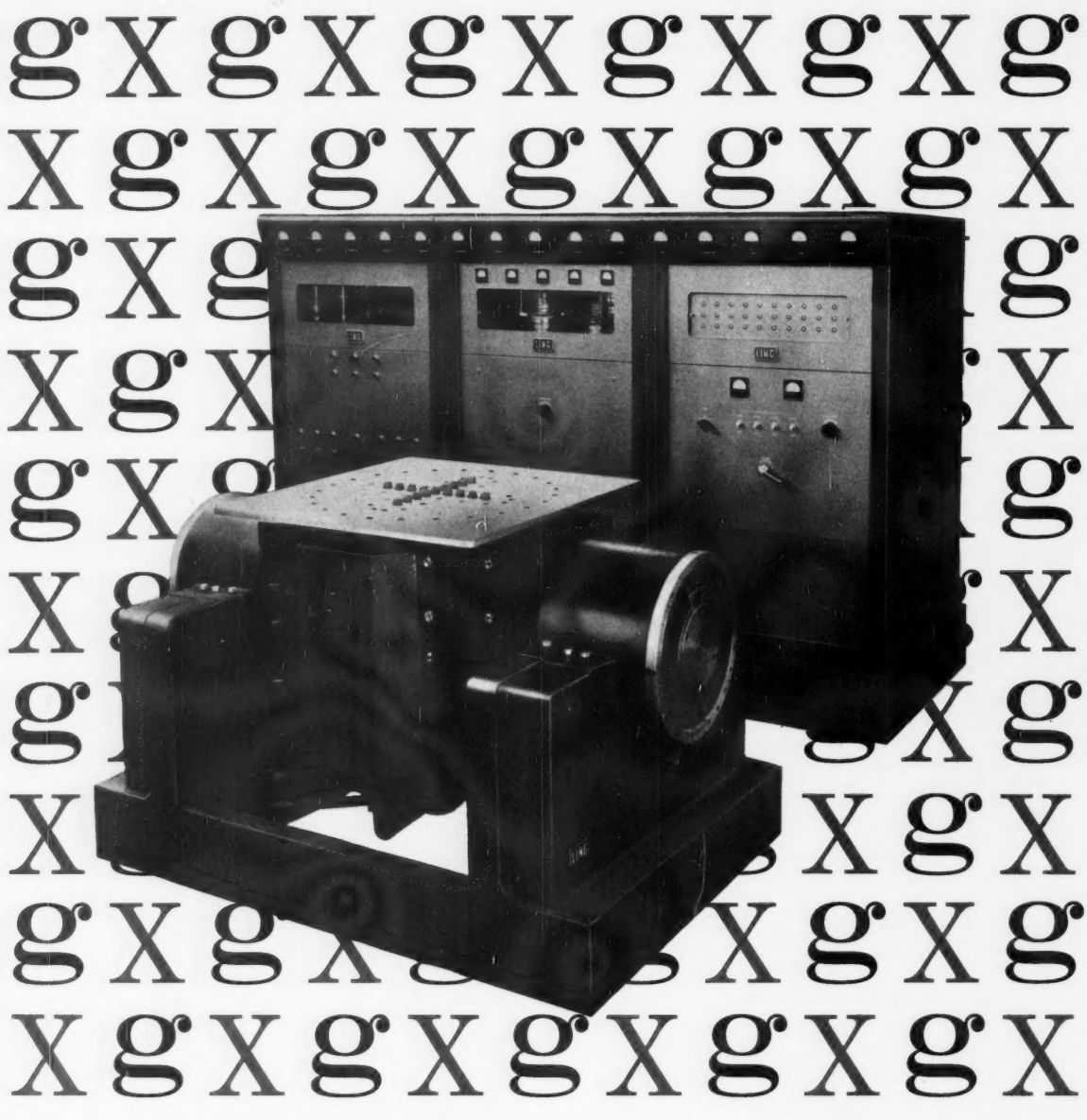
AT LAST . . . A MICROMINIATURE ACCELEROMETER THAT WORKS!



Introducing a microminiature accelerometer with standard Endevco reliability and performance . . . the Endevco Model 2226 (photo above) for cement mounting. Provides 5.0 pk-mv/pk-g output with six foot cable . . . weighs only 2.75 grams. Also available as Model 2227 with integral 6-32 stud and as the Model 2229 with insulated stud . . . the Model 2228 Tri-Axial Accelerometer is only 0.600" square x 0.420" high. Standard detachable cables are supplied with all Models. Write Department "T."

ENDEVCO CORPORATION

161 East California Boulevard • Pasadena, California • Phone: SYcamore 5-0271



ONLY LING'S NEW X-ARMATURE SHAKER TAKES

75 pound packages to 100 "g"... 208 pounds to 60 "g"

Ling brings you another important development in vibration testing—the revolutionary L-200 Shaker with the capability needed to test heavier packages at higher "g" levels than ever before. The L-200, with a force rating of 20,000 pounds, is designed on a new Ling concept. The unique "X" design armature develops uniform force on two rows of mounting studs which are set in an "X" pattern on the big table. An exceptionally low stray field—less than 3 gauss at table level—protects sensitive guidance packages. The armature weight is only 125 pounds. This, plus efficient coupling, lets you take a 75-pound package up to 100 "g" or a 208-pound package to 60 "g"—a performance no other shaker can match. The L-200's interior is completely sealed off to screen out all chips, dust or contaminants, and is designed to allow environmental test adaptability. For more details on the advantages of the L-200, write to Department JES-661 at the address below.

LING-TEMCO ELECTRONICS, INC.

LING ELECTRONICS DIVISION

1515 SOUTH MANCHESTER, ANAHEIM, CALIFORNIA • PRospect 4-2900